US Army Corps of Engineers®
Memphis District

SECTION III

Northwest Tennessee Regional Harbor

BIOLOGICAL ASSESSMENT

April 2004

DEPARTMENT OF THE ARMY
MEMPHIS DISTRICT CORPS OF ENGINEERS
167 NORTH MAIN STREET B-202
MEMPHIS TN 38103-1894

REPLY TO
ATTENTION OF

March 11, 2004

Planning, Programs, & Project
Management Division
Environmental Branch

Dr. Lee Barclay
U.S. Fish and Wildlife Service
446 Neal Street
Cookeville, Tennessee 38501

Dear Dr. Barclay,

Enclosed is the Biological Assessment (BA) for the Northwest Tennessee Regional Harbor Project on the interior least tern (*Sterna antillarum athalassos*), pallid sturgeon (*Scaphirhynchus albus*), and the bald eagle (*Haliaeetus leucocephalus*). The recommended plan consists of dredging a 9,000-foot long harbor located in a backwater area at Mississippi River Mile 900, Lake County, Tennessee. Total construction would require dredging 1.02 million cubic yards of material and placing it on land in two sites adjacent to the harbor.

The Memphis District conducts least tern surveys annually on the lower Mississippi River. Least tern colonies have been documented across the river and in upstream and downstream locations from the harbor. However, no suitable habitat or colonies have been found in the proposed harbor footprint. No impacts to least tern are anticipated. In order to ensure no impacts, no dredge work would be conducted during least tern nesting and fledging periods (15 June – 15 August, depending on river stages).

A pallid sturgeon survey was conducted in the backwater area on May 13 – 14, 2003, by the U.S. Army Corps of Engineers, Engineer Research and Development Center. No pallid sturgeon were found. The area was surveyed again during low water in September 2003 by the Tennessee Wildlife Resources Agency. No pallid sturgeon were found. Cates Landing backwater does not conform to the characteristic swift water, channel habitats occupied by juvenile and adult pallid sturgeon. No impacts to pallid sturgeon are anticipated. In order to ensure no impacts, no dredge work would be conducted during reported spawning periods (April 12–June 30).

Bald eagle nest surveys were conducted by foot on January 26, 2004, and by air on February 22, 2004. Previously reported eagle nests were observed within 10 miles of the project. However, no nests were observed in the immediate vicinity of the proposed harbor. No impacts to bald eagles are anticipated from harbor construction

Based on the findings of the BA, we do not anticipate any impacts to federally threatened or endangered species. We are concluding that construction of a harbor along the Mississippi

River in the vicinity of Cates Landing would not adversely affect and would not jeopardize the continued existence of the interior least tern, pallid sturgeon, and bald eagle.

We are requesting your comments concerning this BA. Please contact Danny Ward at (901) 544-0709 or daniel.d.ward@mvm02.usace.army.mil if you have any questions concerning this submittal. A copy of this submittal is being sent to Mr. Rob Todd with TWRA, Fisheries Division.

Sincerely,

David L. Reece
Chief, Environmental Branch

Enclosures

NORTHWEST TENNESSEE REGIONAL HARBOR

ENDANGERED SPECIES
BIOLOGICAL ASSESSMENT

INTRODUCTION

This Biological Assessment (BA) evaluates the potential impacts to federally listed threatened and endangered species of constructing the Northwest Tennessee Harbor Project, Lake County, Tennessee. The species listed that are the focus of the BA are the interior least tern (*Sterna antillarum athalassos*), pallid sturgeon (*Scaphirhynchus albus*), and the bald eagle (*Haliaeetus leucocephalus*). Pertinent biological and ecological data for these endangered species are based on both published and unpublished literature, communications with experts, and findings of recent U.S. Army Corps of Engineers investigations. The BA has been submitted to the U.S. Fish and Wildlife Service pursuant to Section 7 of the Endangered Species Act, as amended; and is included as part of the Draft Environmental Assessment for the subject project.

The sicklefin chub (*Macrhybopsis meeki*) was originally listed as a candidate species at the time coordination began with the Service. The sicklefin chub primarily inhabits fast water of large, warm, and turbid rivers over a bottom of firm sand or fine gravel; most likely spawns during spring; and presumably a benthic taste feeder (Robison and Buchanan, 1988). The State of Tennessee lists the sicklefin chub as "in need of management". No specimens were found in the study area during surveys. The U.S. Fish and Wildlife Service determined that it did not warrant listing as threatened and endangered. Impacts from harbor construction would be confined to backwater areas. Therefore, no significant impacts to sicklefin chub populations are expected.

PROPOSED PROJECT

Six alternatives, including the no action alternative, were analyzed during the feasibility study. Alternative 5 was chosen as the recommended plan (Figure 1). Proposed construction would involve dredging a channel within navigational servitude. The proposed channel would be nine feet in depth (with an additional two feet of over dredging), 9,000 feet in length, and have a bottom width of 130 feet transitioning to 225 feet. In addition, a 300-foot turning basin would be constructed at the upstream terminus. Side slopes of the channel would be 1 vertical to 5 horizontal. The harbor would cover approximately 67 surface acres. Total construction would involve the excavation of 1,020,000 cubic yards of sediment. Dredged material would be placed seven feet high in two areas adjacent to the harbor. The first area is a 39-acre site located landside of the Mississippi River Mainline levee and west of Highway 22. The second area is a 66-acre site located in the batture area (the area between the river and the levee).

Unavoidable environmental impacts from the federal project would include the elimination of 60 acres of wetlands with a habitat value of 27 annualized habitat unit value (AHUV). An additional 14 acres of farmed wetlands would also be impacted. The loss of 27 AHUV would be mitigated by

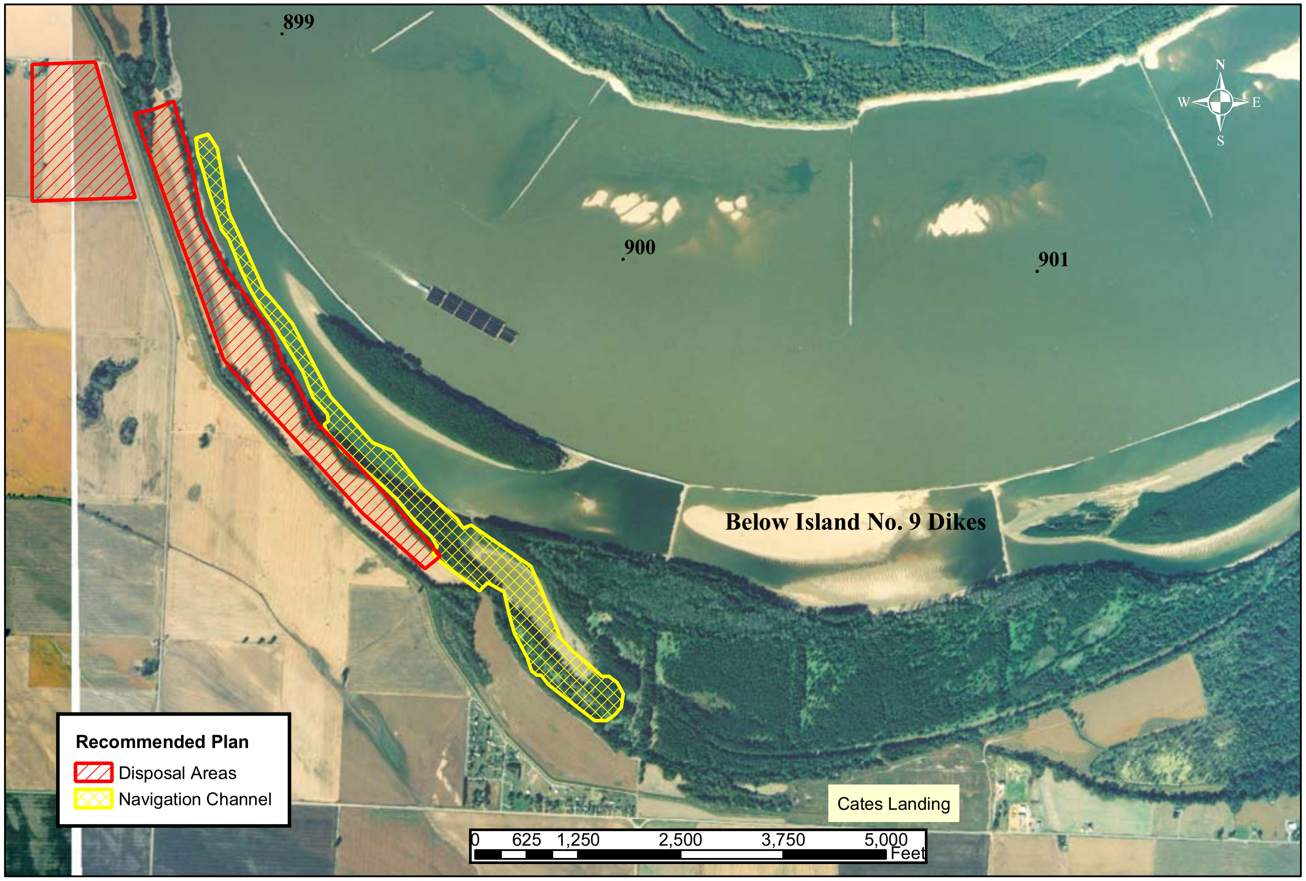

Figure 1. Recommended plan, Northwest Tennessee Regional Harbor, Mississippi River Mile 900, Lake County, Tennessee.

planting bottomland hardwoods on 134 acres of prior converted farmland within suitable locations of the batture land in northwest Tennessee.

The non-federal cost sharing sponsor is the Northwest Tennessee Regional Port Authority. The port authority would construct all site development features to make the harbor usable for navigation. The general service terminal would be located adjacent to the harbor. Fill would be required to raise the general purpose terminal above the Mississippi River 500-year floodplain. The 44 acres surrounding the general purpose terminal would require fill to raise the area above the Mississippi River 100-year floodplain. Fill would be obtained by additional dredging from appropriate locations in the Mississippi River. Approximately 12 acres of vegetated wetlands and 1 acre of farmed wetland would be impacted. Impacts to wetlands would be mitigated by planting bottomland hardwoods on 25 acres of prior converted farmland. The 25 acres would be purchased adjacent to 134 acres mitigation tract stated above.

ENDANGERED SPECIES ASSESSMENT

Sections of this BA have been modified from the Endangered Species Biological Assessment for the St. John's Bayou – New Madrid Floodway Supplemental Environmental Impact Statement (USACE, 2003), the Interior Least Tern Biological Assessment on the Lower Mississippi River completed by the Mississippi Valley Division (USACE, 1999), and the Mississippi River Mainline Levees Project Report (USACE, 1998) prepared by Dr. Jack Kilgore and Dr. Jan Hoover, fishery biologists with the Waterways Experiment Station.

INTERIOR LEAST TERN *Sterna antillarum athalassos*

Description

The interior least tern, *Sterna antillarum athalassos*, was listed as a Federally endangered species on 27 June 1985 (U.S. Fish and Wildlife Service, 1985). The recovery plan (Sidle and Harrison, 1990) for the species was approved on 19 September 1990, but no critical habitat has been designated. Least terns are the smallest of the American terns, measuring from 8.5 inches to 9.75 inches long and having a wingspan of approximately 20 inches. The three United States subspecies are virtually indistinguishable morphologically and are presently distinguished by the separation of their breeding ranges. Least terns have a black-capped crown, white forehead, a black-tipped yellow bill, gray back and dorsal wings, white belly, and orange legs. The sexes are virtually identical. Juveniles tend to have a darker, mottled, brownish plumage and bill compared to adults, with a dark band behind the eye and a dark shoulder patch.

Taxonomic Status

The least tern species (*Sterna antillarum*) was first described by Lesson in 1847. During the 1940's this bird was classified as a subspecies of the European little tern (*S. albifrons*) (Burleigh and Lowery, 1942). As a result of more recent studies on vocalizations, behavior, and limited morphology, Old and New World least/little terns are now considered separate species. The species name has been returned to *S. antillarum*. Due to taxonomic difficulties, the U.S. Fish and Wildlife Service is uncertain if the interior least tern qualifies as a separate subspecies. However, the Endangered Species Act allows for the listing of vertebrate subspecies as a discrete population.

Historical Range and Population Level

The interior least tern is a migratory, colonial shorebird that breeds and rears its young on islands along much of the Mississippi, Missouri, Arkansas, and Ohio River systems. Downing (1980) performed a partial survey on the lower Mississippi River in 1975 and estimated there were about 1,200 adult birds in the total interior population of the United States and 750 least terns from Cairo, IL to below Osceola, AR. At the time of the Federal listing in 1985, approximately 1,400 to 1,800 terns were believed to be remaining in the total United States population (USFWS, 1985). Past census surveys concentrated on where terns had been found historically and did not seek possible new locations. Hardy (1957) was the first to do the only real census over the entire lower Mississippi River but was limited by time, money and equipment. Recent, more comprehensive surveys indicate the terns move to the first available sandy nesting sites in response to habitat changes. The Corps and many state agencies have attempted to standardize survey techniques and data recording methods. These coordinated surveys have resulted in a greater range and much larger population numbers than expected, especially in the lower Mississippi River Basin (Rumancik, 1986-1995; Jones, 1997-2003).

Least terns arrive on the lower Mississippi River nesting areas from late April through mid May and spend approximately 4 to 5 months at the breeding sites. Courtship and nesting begin in late May and early June through late July, depending upon river stages and the availability of exposed sandbars. Reproduction takes place from late May through early August. Soon after arrival in the breeding area, least terns form colonies ranging from less than a dozen to several hundred birds. Courtship and breeding are followed by nest excavation and egg laying. The shallow nest scrapes are generally on the highest parts of the sandbars, the first parts to become exposed when river stages fall, and located a few yards apart or else widely scattered over the ground. Nest colonies can be from several hundred feet to nearly 3/4 mile long, depending upon the sand bar configuration.

Fall departure from colony sites varies according to the geographic location and the time of nesting. Generally, fall departure is no later than early September. High river stages, which periodically delay nesting into early August, prevent least tern migration until fledglings are mature enough to survive migration. Least terns of the Lower Mississippi River Valley migrate through and winter along the northern and eastern coast of South America, the eastern and western coasts of Central America and the Caribbean Islands, mixing with other least tern subspecies of North America. Exact wintering locations are largely undocumented (Whitman, 1988).

Habitat and Reason for Decline

Interior least terns on the lower Mississippi River choose nest colony sites on large, isolated, bare sandbars or on the upstream and high downstream sandy points of islands. A colony can cover from several hundred square feet to several acres. Almost all colony sites are on land which is separated from the riverbank during the breeding season. Terns do not use grassland or woodland habitat. On the older or larger sandbars, colonies are usually located several hundred yards away from large trees. The specific colony site is almost always on the highest part of the sandbar; the first part to become exposed as high spring river stages recede. Nest sites are well drained and well back from or high above the waterline. Individual nests are shallow depressions scraped out in the bare sand, usually next to a small piece of driftwood, among the debris wrack lines, or within short, sparsely scattered vegetation. On sandbars without driftwood, nests are in bare sand and usually placed on the sand ripple edges. Occasionally nests are in a sandy patch within large gravel areas (Hardy, 1957; Landin et al., 1985; Renken and Smith, 1995; Smith, 1985-1988; Rumancik, 1986-1995; Smith and Renken, 1990, 1991 and 1993).

The primary reason cited in the literature for the decline in the least tern population is habitat loss. The loss is attributed to channelization, dikes and levees for river stabilization, navigation, and flood control; and damming of rivers for flood control, hydropower and recreation (Hardy, 1957; Downing, 1980; USFWS, 1985 and 1990; Smith and Stucky, 1988; Whitman, 1988). Increasing river development for industrial and recreational uses, in addition to increased irrigation water withdrawal from some rivers in the upper Midwest also have caused a decline in available habitat. Least tern habitat may be available in those areas but it is too short-lived to benefit the terns with a fully successful year class. However, in the Lower Mississippi River Valley, habitat conditions are still in a relatively natural condition with up to a 40-foot difference between high and low river stages maintaining the many sandbars used by least terns. Recent data developed during the preparation of a Biological Assessment for the Mississippi River Channel Improvement Project (USACE MVD, 1997) indicate that ample nesting habitat still exists for the interior least tern and its forage fish. That BA also stated that dike construction has generally contributed to the overall increase in Lower Mississippi River sandbar habitat in the past 35 years. Sandbars probably would develop naturally in areas where dikes are located, but would take longer to do so without the dikes.

Little is known about the interior least tern during its migration or on its winter range. Migration habitat characteristics have not been studied in any detail, as they have not been described in literature. However, it appears likely that least terns use similar types of habitat as are used for nesting, resting and foraging during the regular breeding season. Significant habitat problems occurring in these areas may affect a population decline. Further study is warranted.

Additional Data

On the lower Mississippi River, the interior least tern population is generally concentrated along the northern 520 miles of the river from the confluence of the Mississippi and Ohio Rivers at

Cairo, Illinois to slightly below Vicksburg, Mississippi. For the lower Mississippi River, the Recovery Plan goal was for a population between 2,000 and 2,500 adult least terns to remain stable for 10 years, i.e., through 1998 (Sidle and Harrison, 1990). During boat and aerial surveys conducted by the Corps from 1986 to 2003 (Rumancik, 1985-1996; Jones 1997-2003), the numbers of least terns ranged from 1,300 the first year, to more than 8,000 in 2003 (Table 1).

The numbers of least terns recorded within 10 river miles of Cates Landing (Mississippi River mile 890 – 910) are presented in Table 2. Figure 2 provides locations. All Memphis District surveys since 1987 recorded populations well above 2,500 adult birds on 37 to 72 sandbar sites along the river. The average population size since 1994 has been over 5,600 adult birds (Rumancil, personal communication). The majority of these sandbars are within dike fields (Rumancik 1986-1995, Jones 1997-2003). Upon review of the Recovery Plan and other available breeding season data for the interior least tern, it is apparent that the Mississippi River Basin contains the largest remaining population of least terns. Nearly 3/4 of the total United States interior population occurs between Cairo, Illinois and Natchez, Mississippi (Rumancik, 1986-1995; Sidle and Harrison , 1990; USACE MVD, 1997; Jones, 1997 – 2003; USFWS, 1998).

<u>Fish Species Utilized by Least Terns</u>: The Mississippi River, and in general, its floodplain between the levees provide thousands of acres of diverse habitat that become available for fish spawning during the spring. Many different fish species use the various habitats from open water river channel to shallow water around the sandbars, and in flooded cropland (Tibbs, 1995).

Tibbs (1995) studied the habitat use by small fishes in the lower Mississippi River related to foraging by least terns. He found the following fish dominant in his Mississippi River collections.

Fish Name	Species Name
Skipjack herring	*Alosa chrysochloris*
Gizzard shad	*Dorosoma cepedianum*
Threadfin shad	*Dorosoma petenense*
Freshwater drum	*Aplodinotus grunniens*
White bass	*Morone chrysops*
Buffalo	*Ictiobus spp.*
Carp	*Cyprinus carpio*
River carpsucker	*Carpoides carpio*

Similar results were found by sampling events conducted by the Tennessee Wildlife Resources Agency in the proposed harbor area (USACE, 2004). Smith and Renken (1990) reported several genera of fish dropped by least terns on the sand bar at colonies in the lower Mississippi River. The three principal taxa found were: shad spp. (73%), river carpsucker (16%), and shiner (*Notropis* spp. 6%). Other genera included pickerel (*Esox*), mooneye (*Hiodon)*, sunfish (*Lepomis* and *Micropterus*), golden shiner (*Notemigonus crysoleucas*), madtom (*Noturus*), and crappie (*Pomoxis*). Small fish found dropped on sand bars during surveys conducted by the Corps include: bluegill (*Lepomis macrochirus*), largemouth bass (*Micropterus salmoides*), white crappie (*Pomoxis*

Table 1. Summary of least tern surveys 1985 – 2003, Lower Mississippi River (Rumancik, 1985 – 1996; Jones, 1996 – 2003).

	1985	**1986**	**1987**	**1988**	**1989**	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**
Aerial																			
Individuals	187	1332	1125	1018	2503	4182	3358	2311	4589	3303	3759	3677	2129	0	0	0	0	0	0
Sites	12	37	49	56	58	56	67	80	66	66	63	81	81	0	0	0	0	0	0
Colonies	3	16	24	31	46	36	56	61	46	40	51	20	23	0	0	0	0	0	0
Towboat																			
Individuals	577	595	575	1,235	508	357	1154	1216	2031	965	489	0	0	0	0	0	0	0	0
Sites	35	39	45	71	25	31	39	47	48	39	25	0	0	0	0	0	0	0	0
Colonies	15	16	21	33	9	3	29	34	21	30	1	0	0	0	0	0	0	0	0
Small Boat																			
Individuals	0	2188	2206	2356	2005	5038	4297	3653	0	6776	6971	3067	3428	5538	6159	5920	6361	5802	8082
Sites	0	41	50	72	64	38	66	81	0	78	70	47	79	91	134	124	141	100	115
Colonies	0	28	46	60	42	32	57	74	0	69	62	31	57	39	38	64	54	68	68

Table 2. Lest terns observed by small boat within 10 river miles of Cates Landing, Tennessee (Mississippi River Miles 890 – 910) from 1986 to 2003.

River Mile	**Description**	**Years Observed**	**Number Observed**	**Colony**
909	Mable Landing/Milton Bell Light	1996	40	Yes
		1997	43	No
		2000	2	No
908	Island #6	1990	65	Yes
		1992	17	Yes
		1995	-	
		1999	4	No
		2001	7	No
		2002	16	No
		2003	2	No
907	Island #9 Revetment	2000	4	No
902.1	Donaldson Point Dikes	2001	14	No
902	Below Island #9 Dikes	2000	3	No
		1991	26	Yes
		1992	62	Yes
		1993	80	Yes
		1995	-	
901	Below Island #9 Dikes	1988	23	Yes
		2001	9	No
900	Below Island #9 Dikes	1987	70	Yes
		1988	48	Yes
		1994	60	Yes
		1997	23	Yes
		1998	17	No

Table 2. Continued.

River Mile	Description	Years Observed	Number Observed	Colony
895	Hotchkiss Bend Bar/Dikes	1987	80	Yes
		1988	22	Yes
		1989	6	Yes
		1990	500	Yes
		1991	200	Yes
		1992	65	Yes
		1993	7	No
		1994	40	Yes
		1995	-	
		1996	68	Yes
		1997	35	Yes
		1998	156	Yes
		1999	170	Yes
895	Hotch Kiss Bend Bar/Dikes	2000	49	Yes
		2001	13	No
		2002	12	No
		2003	37	Yes
894	Hotchkiss Bend Dikes - Lower	1991	50	Yes
892	Kentucky Point	2001	3	No
890	Kentucky Point Dikes	1986	10	Yes
		2001	3	No

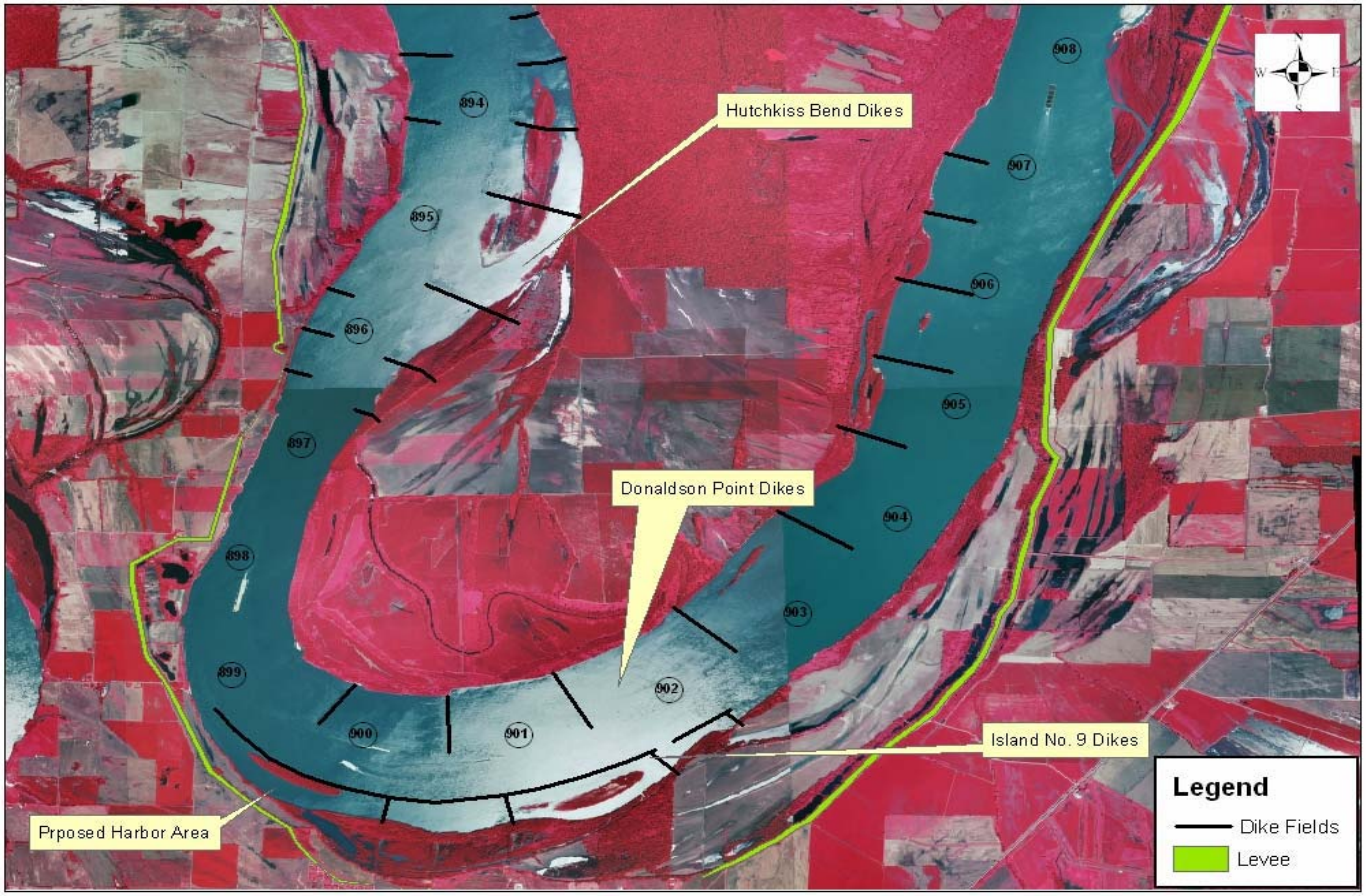

Figure 2. Mississippi River Mile 894 – 908, Northwest Tennessee Regional Harbor, Lake County, Tennessee.

annularis), redear sunfish (*Lepomis microlophus*), topminnow (*Fundulus* spp.), threadfin shad, gizzard shad, white bass, freshwater drum, and buffalo (Rumancik 1986-1995, Jones 1997-2003). The vast majority of fish found on the sandbars were shad. All fish found on the sand were recorded to have an average total length of 2.25 inches. Smith and Renken (1990) recorded a size range from 0.79 inches to 3.54 inches.

Forage Fish Abundance: River stage determines the types and amounts of fish and fishery habitat available (Dugger, 1997). In their study of the influence river stage plays on prey fish, Tibbs and Galat (1998) stated that forage availability is greater during the least tern nesting period than before terns arrive. They also found that fish abundance was temporally related to the April flood. Most fish they collected belonged to species known to spawn on the floodplain, which led them to conclude there is linkage between the spring flood and forage availability for least terns in June.

High spring Mississippi River stages recede to within banks and redistribute the young of the year and small-fish in various densities among the riverine habitats. A survey by Baker et al. (1987) from Wolfe Island revealed that the highest fish densities occurred near the surface along the natural river bank with decreasing densities along the secondary channel sand bar and then in midchannel. Midchannel fish densities showed slightly greater numbers as depth increased. Average fish length was between 1.4 inches and 2.25 inches. Another sampling at Island No. 8 revealed the greatest concentrations of fish were found at the secondary channel sand bar and along the natural bank, while lower numbers of fish were found in midchannel. Baker et al. (1987) also found that fish at the natural bank tended to be surface-oriented compared to those in other parts of the river. This orientation would make fish readily available least tern forage.

Tibbs (1995) found his forage fish sampling showed sharp peaks in the numbers of small fish captured indicating high abundance of forage for the least tern during a relatively short period of time with greatly reduced availability both before and after peaks. Peak forage fish densities consistently occurred prior to the period of maximum forage demand (the chick rearing period). Densities of forage fishes were initially low at the start of nesting, peaked somewhere in the middle of nesting, and then declined near the end of the nest initiation period. From this it can be surmised that the abundance of small fish around the sand bars is available for a relatively short time early in the nesting season, and the terns are obliged to seek other prey in other deep water areas of the river as hatching begins.

Forage fish abundance and productivity appear to be good throughout the various river habitats. Baker et al. (1988) demonstrated good abundance and diversity of forage fish in the lower Mississippi River sand bar, natural and revetted bank, and diked secondary channel habitats. Their fish measurements in diked secondary channels at slack-water conditions revealed that forage-sized individuals numerically dominate the fish assemblage. The survey of fish populations along natural and revetted banks on the Lower Mississippi River by Pennington et al. (1983) revealed that the greatest number of fish collected in all samples along the 2 revetted and 2 natural river banks they studied was gizzard shad (42.7% - 61.9%). They also found that species composition and relative abundance along natural banks were similar to data sampled by others near Grand Gulf, Mississippi, between river miles 400-410 (NUS Corporation, 1974) and in the vicinity of Cape Girardeau, Missouri, near upper river mile 50 (Robinson, 1972; Bertrand and Allen, 1973).

Data obtained from the present fish sampling (USACE, 2004) also show similar results in the proposed harbor area. Gizzard shad was the dominate species observed by electroshocking surveys in the harbor area. They also accounted for 41% of the total biomass.

The many diverse aquatic habitats within the dike fields in the lower Mississippi River exhibit higher primary productivity and greater fish densities than adjacent riverine habitats (Pennington et al., 1983). Specifically, between 1987 and 1990, the Corps of Engineers conducted extensive surveys of the Mississippi River fisheries along 214 miles of the river from river mile 883, near New Madrid, Missouri, to river mile 669, near Helena, Arkansas. Gizzard shad were the most abundant species collected in lentic backwaters, ranging from 51.5% of the catch in 1989 to 82.1% in 1990. The greatest numbers were in the age-0 and age-1 year classes (Rutherford et al., 1994). These year class sizes would provide the proper < 2.25 in. size fish for least tern forage fish. The species composition of fish collected by Rutherford et al. (1994) support the findings of Baker et al. (1988). They found that certain aquatic habitats associated with wing-dam (dike field) complexes in the lower Mississippi River were used for spawning and nursery areas by fishes normally found in off-channel habitats. Collections in shallow-water areas associated with sand islands within these complexes yielded large numbers of fishes, dominated by juveniles of larger-sized fish species. They concluded that aquatic habitats associated with wing-dam complexes within the river's banks functioned much like off-channel floodplain habitats. The availability of these shallow water habitats, after high river stages recede in late spring to early summer, made these habitats less than optimal for spawning for some fish species. To improve the overall fishery habitat within the dike fields, the Corps is currently designing notches in all dikes, where feasible, and creating notches in existing dikes. These notches have been successful in increasing shallow-water fishery habitat, near least tern nesting colonies as Shields (1988) describes.

Based on the information contained in the previous paragraphs, it appears there is an abundance of diverse fishery habitat throughout the Lower Mississippi River, especially in shallow water and among dike fields, and an ample supply of forage-sized fish (particularly shad) to support the existing high least tern population. These should influence least tern foraging areas and foraging success.

Least Tern Foraging Areas: Least tern foraging habitat in the Mississippi River primarily includes shallow water at, (1) the river side shore of the nesting colony, (2) along revetted riverbank on the opposite side of the river from a colony, and (3) over current divergences (boils) in the main river channel. Lesser fishing sites are at the mouths of tributary streams, turbulent water around dikes, backwater chutes, and occasionally ponds and lakes near the river (Dugger, 1997). On population surveys conducted by the Corps, least terns were regularly observed fishing along the opposite revetted river bank, 3/4 to 1 mile away and 2.5 miles upstream and downstream from a nesting colony. This fishing area itself could be 3/4 mile long (Rumancik, 1986-1995; Jones, 1997-2003). This contrasts with foraging least terns on the small rivers in Nebraska. There, terns rarely ventured farther than 100 yards from their nesting colony (Faanes, 1983). Least terns also were observed fishing in the rough water among dikes, at mouths of tributary streams, and in the calm back chutes behind the sandbars. Fishing in flooded fields is limited to early in the season, or when the river remains high well into July. However, in normal years, high spring water has receded to the channel prior to tern arrival (Sidle and Harrison, 1990). This compares with Smith and Renken (1990) who observed terns foraging in many aquatic habitats along the river, with their estimated maximum foraging distance up to 2 miles from a nesting colony. It appears that shallow, near-shore water and the revetted river banks are preferred least tern foraging areas, but flooded shallow areas also are used when fish are present. From these observations, it is reasonable to conclude that since least terns are opportunistic feeders, they will forage where the fish are and where they are easiest to catch.

Impacts to Least Tern

Least tern colonies have been observed in the main river channel in the vicinity of the proposed harbor. The current dike configuration in the area has eliminated the sandbar that was once directly adjacent to the proposed harbor. However, recent colonies have been observed across the river in the relatively near Donaldson Point Dikes (RM 902), upriver at Island #6 (RM 908), and downstream at Hotchkiss Bend (RM 895). The proposed harbor site does not contain suitable nesting habitat. Observations by Rumancik (1985 – 1995) and Jones (1997 – 2003) suggest that nesting terns show little concern over any kind of encroachment by land or water, by humans, their pets, or machinery at a distance of 300 feet. It is highly unlikely that construction of the harbor would impact nesting terns across the river. However, to further ensure no impact would take place, no dredge work would be conducted during reported nesting and fledging periods (approximately 15 June to August 12, depending on specific river stages and the latest population survey).

Along 110 miles of the Mississippi River between Cairo, Illinois, and Caruthersville, Missouri, approximately 177,570 acres are available for fish spawning in the 2-year Mississippi River floodplain. The recommended plan would remove 46 acres of frequently flooded habitat on Old Slough Landing. This loss represents a minute percentage of the 2-year Mississippi River floodplain within this reach of the river. Ample spawning habitat would remain in the Lower Mississippi River that would continue to produce diverse and abundant forage fish populations. Construction of the harbor would not significantly impact forage fish population size or spawning habitat.

Least terns are mobile, opportunistic feeders foraging over the entire river channel and up to 2.5 miles upstream and downstream from a colony. Terns are expected to fish in the harbor once construction is complete.

It can be concluded that least tern colonies have not been found within the specific harbor footprint and construction would not impact colonies in the vicinity. The loss of spawning habitat from harbor construction would not significantly alter forage fish populations. Therefore, constructing a harbor at Cates Landing is not expected to adversely impact nesting habitat, courtship behavior, foraging strategy, and the stability of the overall least tern population in the Lower Mississippi River Valley.

PALLID STURGEON *Scaphirhynchus albus*

Description

The pallid sturgeon was listed Federally as an endangered species on 6 September 1990 (Federal Register 55: 36647, U.S. Fish and Wildlife Service 1994), and a recovery plan was approved 7 November 1993 (Dryer and Sandvol 1993). Prior to this, it was listed as a threatened or endangered species by 9 of the 13 states in which it occurred (Kallemeyn 1983). It was also listed as threatened, later endangered throughout its range by the Endangered Species committee of the American Fisheries Society (Deacon et al. 1979, Williams et al. 1989). Imperilment of this species is attributed to "destruction, modification, or curtailment of its habitat or range" and "other natural or manmade phenomena" (Williams et al. 1989).

The pallid sturgeon is one of only three species of river sturgeons (*Scaphirhynchus spp.*), an ancient group of fishes, which inhabit large, turbid rivers of the central United States. The recently described Alabama sturgeon (*Scaphirhynchus suttkusi*) is endemic to the Mobile Basin. The pallid sturgeon occurs sympatrically with the shovelnose sturgeon (*Scaphirhynchus platorynchus*) in parts of the Mississippi-Missouri River Basin (Lee 1980a, 1980b). The shovelnose sturgeon, however, occurs over a wider geographic range than the pallid sturgeon, inhabiting the upper Mississippi River and formerly inhabiting the Rio Grande Basin from which the pallid sturgeon is unknown.

Taxonomic Status

Fishes characteristic of swift, turbid rivers with high temporal variation in discharge share several morphological features (Cross and Moss 1987). They are ventrally flattened and possess small eyes, hyper-developed cutaneous sense organs, and crowded, embedded scales. Sturgeon, however, are exceptional. They are large, elongate fishes with a pronounced rostrum (hard, forward-projecting snout), five rows of boney plates (one dorsal, two lateral, and two ventrolateral), a muscular extension of the body into the upper lobe of the tail fin, and an inferior protrusible mouth immediately posterior to four fleshy barbels (Robison and Buchanan 1988). River sturgeon differ from other sturgeons by lacking spiracles (small openings into the gill chamber, anterior to the operculum) and by possessing a long filament on the upper lobe of the tail fin and a flat, spadelike rostrum. Both structures have hydrodynamic functions. The caudal filament probably provides sensory input allowing young sturgeon to stay aligned in current and avoid displacement by high velocities (Weisel 1978). The rostrum generates "lift" during swimming and "resistance" during station-holding (Aleev 1963).

The three species of river sturgeons are very similar in appearance and early biologists did not distinguish them from each other. Unusually pale river sturgeons were observed by commercial fisherman, and in 1905, these were recognized as a distinctive form (Forbes and Richardson 1905).

Originally described as a new species belonging to a new genus (*Parascaphirhynchus albus*), the pallid sturgeon was later reevaluated taxonomically based on larger numbers of specimens and reassigned to same genus as the shovelnose sturgeon (Bailey and Cross 1954).

Pallid sturgeon differ from shovelnose sturgeon by their conspicuously lighter coloration and in several morphomeristic characters (Bailey and Cross 1954, Robison and Buchanan 1988, Keenlyne, et al. 1994a). Pallid sturgeon have a greater number of rays in the dorsal fin (37-42 versus 30-36) and anal fin (24-28 versus 18-23). Scales on the belly are absent or reduced compared with those of shovelnose sturgeon. In pallid sturgeon, the bases of the barbels are arranged in an arc and the outer barbels are substantially (1.72-3.54 times) longer than the inner barbels. In shovelnose sturgeon, the bases of the barbels are aligned and the outer barbels are only slightly (1.05-1.78 times) longer than the inner barbel.

Although pallid and shovelnose sturgeons are "readily separable...well-marked species" (Bailey and Cross 1954) and are readily distinguished by field ichthyologists, they are genetically (electrophoretically) indistinguishable (Phelps and Allendorf 1983). This apparent incongruity is attributed to incomplete reproductive isolation of the two species and rapid morphological differentiation.

Historic Range and Population Level

Pallid sturgeon are found throughout the Missouri River, the middle and lower Mississippi River, and in several of larger tributaries including the Yellowstone, Platte, Kansas, St. Francis, Yazoo, Big Sunflower, and Atchafalaya Rivers (Lee et al. 1980a, Kallemeyn 1983, Ross and Brenneman 1991). However, they are more frequently encountered in the Missouri and Atchafalaya Rivers than in the Mississippi River (Dryer and Sandvol 1993, Etnier and Starnes 1993, Constant et al. 1997), but are "nowhere common" (Bailey and Cross 1954, Kallemeyn 1983).

Rarity of the pallid sturgeon is indicated by the paucity of records in the early scientific literature. The original taxonomic description was based on nine specimens collected near the mouth of the Illinois River (Forbes and Richardson 1905). In the next half-century, it was "definitively reported" only from the mouth of the Missouri River and the Mississippi River at Keokuk, Iowa. Redescription of the species was based on 17 specimens from 8 localities (Bailey and Cross 1954). Occurrences in regional fish references are typically based on anecdote (Harland and Speaker 1951), sporadic occurrence (Cross and Collins 1975), or fewer than 5 voucher specimens (Cook 1959, Douglas 1974, Robison and Buchanan 1988, Ross and Brenneman 1991, Etnier and Starnes 1993).

Records compiled for a 70-year period totaled only 250 observations (Kallemeyn 1983). Approximately 76 percent are from the Missouri River in Montana and the Dakotas, and most of those are from reservoirs constructed during the 1950's and 1960's. Only 13 specimens were confirmed from the lower Mississippi River prior to 1983. Since then, a relatively large population (over 100 specimens) has been documented in the Atchafalaya (Constant et al. 1997).

Habitat and Reasons for Decline

Pallid sturgeon, like shovelnose sturgeon, inhabit comparatively large flowing rivers, but pallid sturgeon occur over a narrower range of conditions. They prefer greater turbidity (Bailey and Cross 1954, Lee 1980a; 1980b), finer substrates, and deeper, wider channels. They are more likely than shovelnose sturgeon to occur in sinuous reaches and near long-established islands and alluvial bars (Bramblett 1996). Pallid sturgeon typically inhabit thalwegs and channels of relatively low slope (Constant et al. 1997). Characteristic depths inhabited by pallid sturgeon vary among populations and with river morphometry, but fish typically avoid shallow waters. In the Atchafalaya River, pallid sturgeon inhabited depths of 23 to 69 feet (Constant et al. 1997).

Rarity of the pallid sturgeon makes it difficult to document habitat-related declines in populations, but declining populations and range reductions of paddlefish and shovelnose sturgeon suggest that populations of pallid sturgeon are similarly impacted (Kallemeyn 1983). Reduced numbers and possible extirpations are indicated in Kansas and in Missouri and are attributed to anthropogenic regulation of river flows (Cross and Moss 1987, Pflieger and Grace 1987). Dams block movements of pallid sturgeon, which may have home ranges greater than 185 miles, and populations become segregated and fragmented (Keenlyne et al. 1994, Bramblett 1996). Impoundments also create lentic environments, which are avoided by pallid sturgeon (Constant et al. 1997). Impoundments also reduce discharge, variation in discharge, erosion, turbidity, and presence of fine substrates, habitat factors to which the pallid sturgeon is specifically adapted (Bailey and Cross 1954, Cross and Moss 1987).

Reduced turbidity of water and prevalence of coarse substrates are believed to reduce feeding efficiency of the pallid sturgeon, a turbid water piscivore, and enhance feeding by shovelnose, a clearer water invertivore. Population declines may be attributed to lowland rivers that have become more like upland rivers, favoring shovelnose sturgeon, and possible competition with the more adaptable, but biologically similar species (Pflieger and Grace 1987, Ruelle and Keenlyne 1994). Length-weight relationships for pallid sturgeon in the upper Missouri River suggest that fish of a given size were heavier prior to completion of reservoirs than after the reservoirs were established (Keenlyne and Maxwell 1993).

Water pollution may also have impacted pallid sturgeon populations. Long-lived, bottom-feeding fishes can bioaccumulate heavy metals and organic pesticides in their tissues. In the Missouri River, pallid sturgeon with high concentrations of mercury, cadmium, selenium, PCB’s, DDT’s, chlordane, and dieldrin are documented (Ruelle and Keenlyne 1993). These substances accumulate in multiple organ systems including the kidney, liver, and ovaries. High concentrations are associated with lower growth rates and decreased standing crops of fish. Several of these contaminants are concentrated in egg tissues and probably impair successful reproduction.

Altered habitats reduce isolating mechanisms of sympatric species, and abundance of the two sturgeon species are disparate. Both factors reduce likelihood of intraspecific matings of pallid sturgeon and increase the likelihood of interspecific hybridization. Although some estimates of relative abundance of pallid to shovelnose sturgeon are as high as 1: 5 (Etnier and Starnes 1993), most estimates are much lower, 1:20 to 1:400 (Kallemeyn 1983, Carlson et al. 1985). Collections of more than 300 sturgeon in the lower Mississippi River suggest a ratio of approximately 1 pallid for every 30 shovelnose sturgeon (Hoover and Killgore, unpublished data).

Hybridization between shovelnose and pallid sturgeon has not been extensively documented and is believed to be a recent phenomenon (Carlson et al. 1985). Values for morphological and meristic characters of hybrids are intermediate between those of shovelnose and pallid sturgeon. Hybrids also demonstrate intermediate growth rates and levels of piscivory when compared with those of the parent species. Initially, documented percentage of hybrids was low (less than 0.5 percent of sturgeon), but more recent estimates have indicated high percentages in the middle Mississippi River (86.4 percent) and in the Atchafalaya River (43.8 percent) (Keenlyne et al. 1994b). These hybrids are not intermediate in all morphomeristic characters suggesting that they are not F1 hybrids (first generation offspring of two different species).

Commercial fishing may also impact pallid sturgeon. Historically, river sturgeon were occasionally targeted by commercial fishermen and were frequently obtained as bycatch. Large specimens, including pallid sturgeon, were exploited for caviar, and smaller specimens, including shovelnose sturgeon, were discarded as nuisances (Carlander 1969, Moos 1978). Commercial fishing is believed to have contributed to declines of both species since the early 20th century. Consequently, several states now prohibit fishing for and retention of any river sturgeon.

Life History

Little life history information is available for pallid sturgeon (Bailey and Cross 1954, Carlander 1969, Kallemeyn 1983). Available data are typically based on small numbers of observations from a few localities. Juveniles and small adults are not well represented in museum collections (B. Kahajda, personal communication) or in contemporary studies of ecology, movement, etc. (e.g., Carlander 1969, Carlson et al. 1985, Keenlyne et al. 1992, Keenlyne et al. 1994, Bramblett 1996, Liebelt 1996, Constant et al. 1997). Information on age and growth is based principally on observations of adults and back calculations of sizes at different ages indicated by growth rings in the pectoral rays (Kallemeyn 1983).

Pallid sturgeon are large, long-lived, and slow to mature. They attain sizes of 65 inches total length (TL) and 68 pounds, although adult sizes of 23 to 35 inches TL are probably typical (Carlander 1969, Lee 1980a, Kallemeyn 1983). The age of one individual (approximately 59 inches TL) and 37 pounds was estimated at 41 years. Pallid sturgeon probably attain greater ages than this (Keenlyne et al. 1992). Age of sexual maturity is 5 to 7 years for males and 9 to 12 years for females, but first spawning may not begin until age 15 to 17 years or later (Keenlyne and Jenkins 1993). Sex ratios may be skewed. Females outnumbered males 2:1 throughout the Missouri and Mississippi Rivers (Carlson et al. 1985), but 13 specimens collected in the middle Mississippi River consisted of 12 males and 1 undetermined individual (R. Sheehan, personal communication). Fecundity, however, is high. One very large female contained 170,000 eggs, approximately 11 percent of her body weight (Keenlyne et al. 1992).

Spawning has never been observed (Kallemeyn 1983). Larvae, distinctive and distinguishable from shovelnose sturgeon have not been collected in the field. Based on apparent reproductive conditions of adults, the spawning season is believed to be during spring, initiation dependent upon latitude and timing of proximate cues like spring runoff. It is presumed to take place during high water. Spawning probably begins in March in the lower Mississippi and Atchafalaya Rivers, late April or early May in the lower Missouri and middle Mississippi Rivers, and late May or early June in the upper Missouri River (Keenlyne and Jenkins 1993).

Growth during the first year is rapid. At age-1, pallid sturgeon are approximately 11 inches TL and weigh just over 1 ounce. They grow an additional 4 inches per year during the following 3 years, and 1.2 to 2.4 inches per year after age 5 (Kallemeyn 1983). From approximately age 2 to 6, weight increases 2.1 to 8.8 ounces per year; in larger (>26.4 inches TL), older fish, weight increases more than 12.3 ounces per year (Keenlyne and Maxwell 1993).

Pallid sturgeon, like shovelnose sturgeon, feed on aquatic insects, but unlike shovelnose sturgeon, also consume fish (Carlson et al. 1985). Dominant prey (greater than 35 percent total food volume) are caddis flies (Trichoptera) and fishes. Other insects are eaten frequently, but comprise smaller portions of the diet (less than 10 percent total food volume). These include naiads of mayflies (Ephemeroptera), dragonflies and damselflies (Odonata), and larvae of true flies (Diptera). Plant material is also frequently ingested but in small quantities. Captive specimens can be maintained on a steady diet of fish (Bramblett 1996).

Additional Data

General and project specific permits issued by the Corps recognize potential dredging-related risks to spawning pallid sturgeon. Dredging is prohibited during presumed "windows" of pallid sturgeon reproduction, 1 April through 30 June in New Orleans and Vicksburg Districts and 12 April through 30 June in the Memphis District.

River sturgeon have been sampled by U.S. Army Engineer Waterways Experiment Station in the lower Mississippi River near the confluence of the Arkansas River (Hoover and Killgore, unpublished data). In 1995 and 1996, approximately 200 sturgeon were collected. Most were tagged with passive integrated transponder tags and Peterson discs and released; others were retained for a morphological study of shovelnose sturgeon. A few specimens (less than 10) were pallid sturgeon or hybrids. During January and February 1997, 127 sturgeon collected for a study of morphological differences between pallid and shovelnose sturgeon also provided data on relative abundance and habitats of the two species. Pallid sturgeon numbered 4, shovelnose 123, with no obvious hybrids. Shallow (less than 15 feet deep), near-shore (less than 100 feet from water's edge) habitat was not sampled, but pallid sturgeon occupied a narrower range of conditions than did shovelnose sturgeon. Three of the four pallid sturgeon were collected more than 250 feet from shore and all were collected in depths greater than 35 feet. The Missouri Department of Conservation has recently captured 15-20 pallid sturgeon from the Mississippi River near Caruthersvile, Missouri. They also stocked the Mississippi River with 7,200 young pallid sturgeon in 1994 and 3,300 sturgeon in 1997. Over 150 pallid sturgeon were recaptured through their monitoring efforts, with only 2 individuals found in tributary streams (Kim Graham, pers. comm.). Observations support previous studies demonstrating that pallid sturgeon occupy midchannels and deeper water more frequently than do shovelnose sturgeon, which are more likely to occur in shallower, near-shore waters (Moos 1978, Bramblett 1996, Constant et al. 1997).

A pallid sturgeon survey was conducted in the proposed harbor area during13-14 May 2003 (USACE ERDC, 2003). Cates Landing backwater does not conform to the characteristic swiftwater, channel habitats occupied by juvenile and adult pallid sturgeon. However, high abundances of larval fish comprised of multiple species were observed in the backwater, particularly in vegetated areas where cover was readily available. These areas were not surveyed. A low water survey was conducted by the Tennessee Wildlife Resources Agency in late September 2003 (USACE, 2004). No pallid sturgeon were found. The vegetated areas were not flooded at the time of the survey.

Impacts to Pallid Sturgeon

Project-related impacts to the pallid sturgeon population in the lower Mississippi River are not foreseen. Pallid sturgeon avoid shallow water and typically inhabit deep thalwegs with hard-packed, sandy substrate, and channels of relatively low slope in large rivers. These habitats do not coincide with the proposed harbor location. No sturgeon were sampled during high water surveys conducted in May and low water surveys conducted in September.

Pallid sturgeon may use the flooded areas of Old Slough Landing for spawning and or rearing habitat. In order to ensure no likely impacts, harbor construction would not take place during reported spawning periods (12 April – 30 June, depending on river stages).

Harbor construction would likely begin in mid-August. The area of Old Slough Landing is usually dry during this period and low water usually lasts until late November. Dredging the navigation channel is schedule to take approximately 12 - 15 weeks so the area would most likely not be flooded during construction. Therefore, it is highly unlikely that sturgeon would be impacted during construction.

BALD EAGLE *Haliaeetus leucocephalus*

Description

The bald eagle is a large raptor, having a wingspan of about 7 feet, is 3.5 feet long, and weighs about 8-15 pounds. Its plumage is mainly dark brown; adults have a pure white head and tail. First-year juveniles are often chocolate brown to blackish, sometimes with white mottling on the tail, belly, and underwings. The head and tail become increasingly white with age until full adult plumage is reached in the fifth or sixth year. The sexes are identical in color, but size is variable and cannot be used conclusively for identification. An opportunistic predator, the bald eagle feeds primarily on fish, but also takes a variety of live birds, mammals, turtles and carrion. Fish compose 60 to 90 percent of the bald eagle diet.

Taxonomic Status

Historically two species of bald eagle were recognized, the southern bald eagle, *Haliaeetus leucocephalus leucocephalus,* and the northern bald eagle*, Haliaeetus leucocephalus alascanus*. These two subspecies names were in use when the southern bald eagle was listed 11 March 1967, as endangered under the Endangered Species Protection Act of 1966. Previously, the bald eagle had been listed as endangered in all states except Washington, Oregon, Minnesota, Wisconsin, and Michigan. By the time the bald eagle was listed as endangered for the entire lower 48 states, the subspecies was no longer recognized by ornithologists. The U.S. Fish and Wildlife Service reclassified the bald eagle (*Haliaeetus leucocephalus*) from endangered to threatened throughout the 48 conterminous states on 12 July 1995.

Range and Population

With the exception of extreme northern Alaska and Canada and central and southern Mexico, the bald eagle historically ranged throughout North America. The eagle breeding season varies with latitude. However, the general tendency is for winter breeding in the South with a progressive shift toward spring breeding in northern locations. According to personal communication with local biologists (Bob Hatcher, Tennessee Wildlife Resources Agency; Charlie Shaiffer, Mingo Refuge; and Jim D. Wilson, Missouri Department of Conservation), the bald eagle generally lays two (and sometimes three) eggs in mid-February in southeastern Missouri and northwestern Tennessee. Egg laying may be delayed into March and April, depending upon the weather. The eggs are dull white in color and are laid at intervals of several days. Both parents incubate the eggs for 34 to 40 days. Re-nesting may occur if the eggs are lost early in incubation. By 10-11 weeks of age (usually in June, but as late as August 16), eaglets are feathered, nearly full grown and able to fly from the nest (Missouri Department of Conservation 1998). The adult eagles continue to care for the eaglets for approximately 4 to 6 weeks after fledging. Bald eagles mature slowly, requiring 4 to 5 years to gain adult plumage and reach breeding age.

In the 17 years since it was listed throughout the conterminous 48 states, the bald eagle has increased in number and expanded in range. In 1963, a National Audubon Society survey reported 417 active nests or eagle pairs in the lower 48 states. Productivity was 0.59 young per active nest. By 1974, the number of active nests had risen to 4,452 and productivity was estimated to be 1.17 young per active nest. By 1998, the average young per nest was 1.1 to 1.3 with more than 10,000 nesting pairs in the lower 48 states (Missouri Department of Conservation 1998).

Habitat and Reason for Decline

The bald eagle primarily selects riparian habitat and usually nests near bodies of water where it feeds. Selection of nesting sites varies according to tree species in a particular area. Nests are usually constructed in living trees; however, bald eagles do occasionally use dead trees. They usually build nests in the top of a giant tree. Enlarged annually, a bald eagle nest can become the largest of any North American bird; the record is 20 feet deep, 10 feet wide, and weighed two tons (Missouri Department of Conservation 1998).

Bald eagles frequently re-use nest structures in subsequent years and often for periods of many years. Quite often, eagles will build and use a new nest near a previous nest. Sometimes several nests will accumulate in such a manner in a particular area, although only one will be used for a nesting attempt during any given season. Although eagles often use particular nests for many years, they frequently move to different sites. Turnover of existing nests may be as much as 12% of the sites per year (Grier et al. 1983).

The major factor leading to the decline of the bald eagle was lowered reproductive success following the introduction of the pesticide DDT in 1947. DDT residues caused egg-shell thinning which led to broken eggs. The use of DDT was suspended in 1972, and by the late 1970's, eagle populations began to recover. Current factors affecting the bald eagle recovery include habitat destruction, disturbance by humans, electrocution, illegal shooting, impact injuries, and lead poisoning.

Bald eagle tolerance of disturbance is least during egg laying, incubation and the first several weeks after hatching. Disturbance, although difficult to assess and evaluate, has been suggested as a cause of reproductive failure in some breeding areas and a factor that adversely affects the suitability of wintering areas (Grier et al. 1983).

Eagle tolerance of human presence is highly variable, both seasonally and among different individuals or pairs of eagles. Some bald eagles nest and accept people, boaters, hikers, cabins, roads, and other human presence in very close proximity, possibly as a result of habituation. On the other hand, some may be extremely intolerant and be disturbed readily (Murphy et al. 1984).

All nesting eagles are disturbed more easily at some times of the nesting season than at others. Four periods of sensitivity to disturbance can be identified for nesting areas. These are as follows (Grier et al. 1983):

1. Most critical period: Prior to egg laying bald eagles engage in courtship activities and nest building. During this and the incubation period, they are most intolerant of external disturbances and may readily abandon the area. The most critical period for disturbances, therefore extends from approximately one month prior to egg laying through the incubation period. Within the project area, this period may range from January through April.

2. Moderately critical period: This includes approximately one month prior to the above period and about four weeks after hatching. Prior to the nesting season individual pairs of eagles very considerably in the time they return to the nest site or, if permanent residents, the time they begin to come into physiological condition for breeding and become sensitive to disturbance. After hatching, the chicks are quite vulnerable to inclement weather and need frequent brooding and feeding. Disturbance can keep adults from nests and, depending on the weather and length of time involved, may cause weakening or death of chicks. Adults are quite protective of the nest site as long as one or more healthy chicks are present. Thus, disturbance at this time is less critical, although still potentially detrimental, than during the pre-laying and incubation period. This period may range from early April to June within the project area.

3. Low critical period: This period extends from the time chicks are about one month of age until approximately six weeks after fledging. During this time adults are still quite attached to nesting areas, but tolerate moderate amounts of human presence. Restriction should be decided on a case by case basis. Within the project area, this period may extend from June through the end of August or early September, depending on the weather conditions.

4. Not critical period: The existence of this period depends on whether adults are permanent residents in their breeding areas. In most regions adults leave the vicinity for a few weeks or months each year. Activities that alter habitat in ways that make it unsuitable for future nesting are the major concern. Within the project area, this period may last from early September to December.

Nesting Eagles

Known eagle nests have been reported along areas adjacent to the Mississippi River in the vicinity of Cates Landing. Within Kentucky, two nests have been reported adjacent to the Mississippi River on Kentucky Point (within 8 miles of the project area) and one nest adjacent to the Mississippi River in the vicinity of Island No. 9 (within 7 miles of the project area). Within Missouri, one nest has been reported in the vicinity of Hubbard Lake in the New Madrid Floodway (within 10 miles of the project area) and one nest across the river on Donaldson Point (within five miles of the project area). Within Tennessee, five nests have been recorded on Reelfoot Lake (within 7 miles of the project area), one nest in the vicinity of Lake Isom (approximately 10 miles from the study area), and one nest along the Mississippi River west of Tiptonville (within 4 miles of the study area).

With the exception of the nests on Reelfoot Lake and Hubbard Lake, all nests were visually verified by aerial survey on 22 February 2004. All nests were verified except the reported nest on Donaldson Point. One eagle was occupying the nest west of Tiptonville. No new nests were discovered during the aerial survey.

Eagles have been observed flying over the proposed harbor. The entire harbor area has been surveyed along the ground for eagle nests on 26 January 2004 and from the air on 22 February 2004.

No nests were discovered. Vegetation consists primarily of black willow at various ages. The majority of the willows are too small to offer suitable nest sites. Small tracts of larger trees exist in disposal areas and site development areas. No eagle nests have been observed.

Wintering Eagles

During the nesting season, bald eagles are rather solitary. However, during winter migration, they become sociable, forming loose flocks in areas where there are remote trees for roosting. Reelfoot Lake is well known for the number of bald eagles that winter in the area. Numbers of wintering eagles in the area have been estimated around 125. Eagles begin to arrive in the area by mid-fall and most arrive by December. In some cases, birds will return to the same area each winter. Wintering eagles begin to migrate north in late February.

Bald eagles are opportunistic feeders during the winter months and congregate in open water areas which permit them to feed on fish or waterfowl, or in upland fields where livestock carcasses, waterfowl, and other game animals draw them away from major river systems (Martell 1992). Eagles usually locate prey by soaring or watching from a high perch. Piracy is another way eagles get food. If one bird makes a prize catch, others will often try to take the food away. In addition to feeding sites, a wintering area usually contains isolated night roosts (Missouri Department of Conservation 1998). At night, wintering eagles often congregate at communal roost trees, in some cases traveling 12 miles or more from feeding areas to roost (Grier et al. 1983).

Impacts to Bald Eagles:

Direct Impacts

No eagle nests have been observed in the construction area. Vegetation to be cleared is not suitable nesting habitat. Construction would take place after nesting season during the non-critical period. No impacts to bald eagles are anticipated.

Indirect Impacts

A 500-acre industrial site is planned to be developed south of the proposed harbor. No suitable trees exist for nesting. However, Reelfoot Lake is located less than three miles away.

Individual eagle pairs exhibit considerable variation in response to human activity depending in part upon the type, frequency, and duration of activity, extent of modification of environment; time in the bird's reproductive cycle; and various other factors not well understood. Therefore, it cannot be predicted with absolute certainty the effects a given disturbance might have on a particular pair of bald eagles.

Several studies have been conducted on the effects of disturbance on eagles. Fraser et al. (1985) found no evidence that human disturbance had a major impact on bald eagle reproduction. He suggested maintaining a buffer of 1,600 feet around the nest because some eagles were able to adapt to disturbance while others were not. Livingston et al. (1990) similarly reported that the closest a human can approach an incubating nest before flushing is 1,600 feet. The proposed industrial area would be well over 1600 feet from any nesting sites. No impacts to nesting eagles are anticipated with site development.

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